January-February 1951

METAL TREATING

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MASTER CRAFTSMEN
METAL TREATING INSTITUTE

JOURNAL OF THE METAL TREATING INSTITUTE

National Trade Association of

COMMERCIAL HEAT TREATERS

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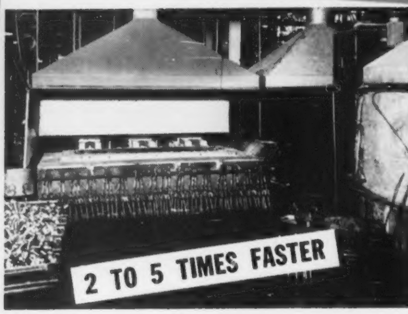

CARBURIZING automobile steering gears. .040 in. case in 2½ hours from 2 to 5 times faster than other carburizing methods.

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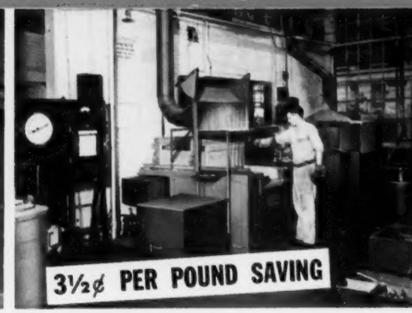

NEUTRAL HARDENING silicon-manganese steel gears without decarburization. Direct savings 3½c per pound of work treated.

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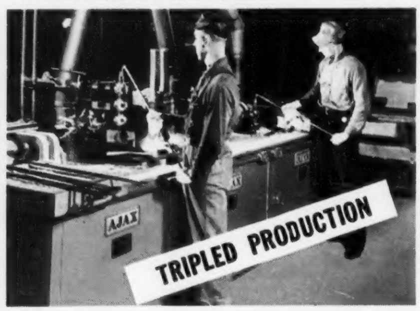

HARDENING HIGH SPEED STEEL TOOLS. No decarburization or surface imperfections. Production increased 3 times over old method.

CYANIDE HARDENING ends of automotive valve pusher rods in 2 mechanized furnace lines reduced labor costs 80%.

Ajax Electric Salt Bath Furnaces are available in a complete range of sizes and types for:

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CYANIDE HARDENING
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STAINLESS STEEL
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HARDENING HIGH SPEED STEEL
AUSTEMPERING
MARTEMPERING
PROCESS ANNEALING
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SOLUTION HEAT TREATMENT
DRAWING (TEMPERING)
DESCALING
CLEANING
DESANDING

...ON 4 HEAT TREATING APPLICATIONS OUT OF 5

Ajax Electric Salt Bath Furnaces offer tremendous advantages over conventional heat treating methods *in almost every case.* This fact is proved beyond question in well over 2,500 installations ranging from small batch type units to huge mechanized furnaces. And, by way of further proof, Ajax will gladly treat a job batch of your materials *under actual shop conditions* in the Ajax Metallurgical Laboratory. Thus you see exactly what results will be obtained, under what labor conditions and at what cost, before you buy.

Get your name on the list to receive TIPS AND TRENDS, the Ajax periodical that will keep you up to date on salt bath heat treating methods and developments. Each issue is chock-full of practical heat treating "know how" written by specialists. Available on request.

THE WORLD'S LARGEST MANUFACTURER OF ELECTRIC HEAT TREATING FURNACES EXCLUSIVELY

AJAX ELECTRIC COMPANY, Inc., 940 Frankford Ave., Philadelphia 23, Pa.

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METAL TREATING

MASTER CRAFTSMEN
METAL TREATING INSTITUTE

Official Journal of the Metal Treating Institute

Editorial...

MAKE A RECORD NOW OF DEFENSE WORK GOING THROUGH YOUR PLANT!

As every member of the Metal Treating Institute and the industry in general knows, the functions of a heat treating plant provide irreplaceable and absolutely essential engineering property characteristics to today's industrial metals. If the skills and equipment of the heat treater were suddenly eliminated, countless designs and specifications would become meaningless and unobtainable and many products vital to the present Rearmament Program simply could not be made.

While it is true that the history of heat treating goes back many centuries, from the days when man first heated then hammered metal, in many ways commercial heat treating could be described as a young industry. One of the reasons for this is that technical and metallurgical progress has been both rapid and substantial in just the past fifteen or twenty years. Methods have been formulated and have become truly scientific, and equipment manufacturers working closely with the demands of users, have helped meet the specification demands of materials' users.

It is not enough, however, that we know this but government departments, Selective Service, and even our suppliers and our valued customers must be kept aware of these facts. A separate day-by-day and week-by-week recording of the essential work being performed in your plant would be of individual value to you, and also will prove a real help to the Institute committee appointed to convey the facts to Washington. Shortly the committee will ask you for such information so, "Make a Record Now of Defense Work Going Through Your Plant."

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JANUARY-FEBRUARY 1951

Vol. II No. 1

FEATURES

DEPARTMENTS

Published by the Metal Treating Institute, 271 North Avenue, New Rochelle, N. Y.

Institute News...

President Walter Rex has appointed the following committees and has listed their duties. These are:

Publication and Technical Committee

Horace C. Knerr, Chairman
Metlab Company
Philadelphia, Pennsylvania
Elmer Cox
Pittsburgh Commercial Heat Treating Co.
Pittsburgh, Pennsylvania
Ben Berlien
Industrial Steel Treating Co.
Oakland, California
Clarence Graham
Metal Treating, Inc.
Milwaukee, Wisconsin
Robert Seger
Chicago Steel Treating Co.
Chicago, Illinois
Fred Heinzelman, Jr.
Fred Heinzelman & Sons Co.
New York, N. Y.
R. G. Sault
Porter Forge & Furnace, Inc.
Somerville, Mass.
Charles Heilman
Commonwealth Industries, Inc.
Detroit, Michigan

The duties of the Publication and Technical Committee are to include those as outlined by Mr. Knerr:

1. Helping to gather editorial material or contribution of suitable articles. Also to gather personal Institute news from member areas and procure news especially from local suppliers in the member's area.
2. Make an active effort to help sell advertising.
3. Advise the editor in connection with the content and handling of "Metal Treating" and assist him in editing material submitted.

Speakers' Committee — For Spring and Fall Meetings, 1951

Howard Bosworth, Chairman
Bosworth Steel Treating Co.
Detroit, Michigan
Leroy Lindberg
Lindberg Steel Treating Co.
Chicago, Illinois
Al Cox
Pittsburgh Commercial Heat Treating Co.
Pittsburgh, Pennsylvania

The duties of this committee will be to arrange for the Speaker at both the Spring Meeting in Glenwood Springs, Colorado and the Fall Meeting to be held in Detroit, Michigan.

Journal Circulation Committee

Purdy Benedict, Chairman
B-M Heat Treating Company
Newark, New Jersey

R. G. Sault
Porter Forge & Furnace, Inc.
Somerville, Mass.

Joseph Bockrath
Wiedemann Machine Company
Philadelphia, Pa.

Charles Hewitt
The Dayton Forging & Heat Treating Co.
Dayton, Ohio

Carl Muehlemeyer
O. T. Muehlemeyer Heat Treating Co.
Rockford, Illinois

Clifford Cook
Cook Heat Treating Co. of Texas
Houston, Texas

William Barrar
Cook Heat Treating Corporation
Los Angeles, California

James Colasanti
Metal Treating & Research Co.
Denver, Colorado

The duties of the Journal Circulation Committee will be to compile an accurate list of all Commercial Heat Treaters, whether Institute members or not, in order to provide an up-to-date list for our journal circulation as well as a list of prospective members. This list should be very accurate and include all commercial heat treaters in the country. Mr. Rex suggests that it be the duties of each member of this committee to search the classified pages of all telephone directories of the states assigned to them by the Chairman of the Committee.

ALFRED C. HUBER

A heart attack caused the death Wednesday, November 8, 1950 of Alfred C. Huber, 46, president of the Supreme Metal Treating Co. and the Huber Metal Processing Co. He lived at 6728 W. Grant Street, West Allis.

Mr. Huber died at St. Mary's hospital after a long illness. The Supreme Metal Treating Co. is at 4440 W. Mitchell Street and the Huber Metal Processing Co. is at 2060 S. 61st Street. Mr. Huber was a member of the West Allis Rotary club and St. Rita's Holy Name society.

PERSONALS

Fred Heinzelman, Senior recently went on a hunting trip in Maine. He bagged a large buck of nearly 200 pounds. We hear that Fred, Sr. is pretty proud of his marksmanship (looks like he should be) and he even shoots with his left hand. As soon as Mrs. Heinzelman has the meat nicely pickled in red wine there will be a real venison party at the Heinzelman manse. If you have a yen for some venison drop a note to Fred—he will send you an invitation and the date.

Fred Heinzelman, Senior, who of course is Past-President Fred Jr.'s dad was one of the original founders of commercial heat treating in the United States. A native of Switzerland where he had received first honors in ornamental and industrial blacksmithing, he came to the United States in 1912 and established his company now known as Fred Heinzelman & Sons Co., New York, N. Y.

* * * * *

Fred Heinzelman, Jr. has bought a new home in Douglaston, Long Island. House warming will be some time in April.

* * * * *

Metlab Company takes pleasure in announcing that Mr. Joseph R. Turner has become associated with them in the capacity of *Manager of Small Parts and Tool Treating Division.*

He will personally supervise the heat treatment of small manufactured parts and of tools, dies and the like. He has brought several of his best heat treaters with him.

Mr. Turner was formerly proprietor and general manager of Turner Heat Treating Company which was recently destroyed by fire. He has had long and successful experience in the Commercial Heat Treating field.

* * * * *

Mr. and Mrs. Richard Thorne recently celebrated their Twenty-fifth Wedding Anniversary in Canada, motoring to Montreal,

(Please turn to page 17)

Austempering of Proving Rings With Minimum Distortion

By Fred Heinzelman, Jr.
Fred Heinzelman & Sons
New York, N. Y.

The austempering technique for heat treatment of steel in thin or small parts has been a well known and tested method of improving certain physical properties of the material. Among the articles frequently so treated, where high physical characteristics and ductility are of major importance, are springs of various types. The minimum of distortion, resulting from the austempering process is, in many applications, just as valued a result as the improvement in properties. It is however, the maintenance of dimension, that received the greatest consideration in the selection of the austempering process for the proving rings to be described.

The rings were made of SAE 52100 tubing steel fully annealed and machined to within .010" of finished size on diameter and width. Figure 1 is a sketch of the units showing required dimensions after heat treatment, and final grinding. Unfortunately, the machine finish of the rings as received, before heat treatment varied from comparatively smooth to almost rough.

TABLE I

	Before Hardening	After Hardening
Max. Var.	.006"	.0075"
Min. Var.	.000"	.002"
Av. Var.	.0026"	.00455"

To further complicate matters the rings not only varied in diameter but were also eccentric as much as .006" as shown in Table I. It was recommended by the customer that the rings be quenched in oil at 1600°F and tempered at 800°F for 1½ hours so as to achieve a hardness of 45-49 Rockwell C.

It was further specified that every precaution was to be taken to avoid deformation in quenching.

Previous experience had shown that parts of this approximate wall thickness and diameter had invariably failed to hold size or shape if treated in this manner. In an effort to determine what size change and distortion would result from any sort of treatment, the rings were checked for size previous to any heat treatment. The wide variations in diameter and eccentricities prohibited the use of jig quenching or jig tempering.

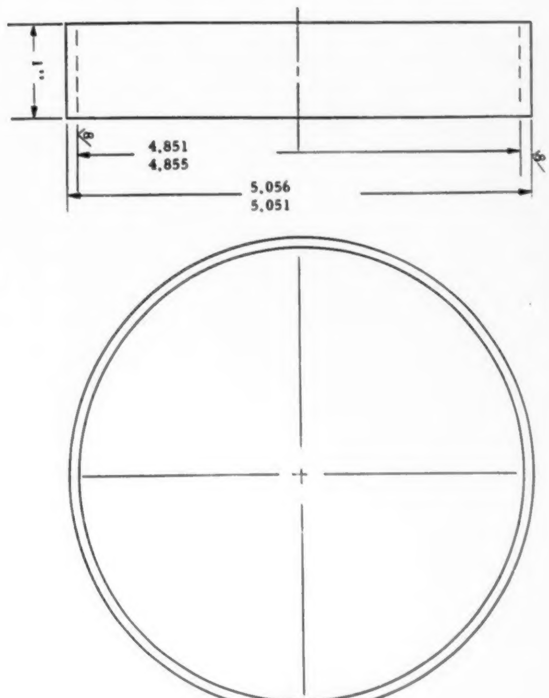


Fig. 1—PROVING RING
MK 2-10
S.A.E. 52100 Steel 2 Req'd.

Allow 0.005 on inside and outside diameters for final grinding after heat treating.

Allow 0.0005 on inside and outside diameters for chrome plating. "Liquid flame hardening" four revolving gears in Ajax Salt Bath Furnace. Teeth are protected from scaling by clinging layer of liquid salt.

The only practical method left was to determine whether or not the rings would keep within the tolerances specified by subjecting them to an austempering treatment. Three rings, arbitrarily selected and checked for size, were first stress relieved at 1200°F for ten minutes in a neutral salt bath and air cooled (Figure 2). These rings were placed as shown in Figure 3 on a three leg support fixture. After stress relief they were checked for size and were found to be within .0005" of the original dimension.

This size change being negligible all the rings were subjected to the identical treatment. Precautions were taken, however, to note the size of every ring before stress relief.

An examination of the Temperature-Time-Transformation curves for SAE 52100 will show quite clearly that grain size is an important factor in considering any treatment for this steel. This presented a problem since the grain size or chemical composition of the rings could not be determined without destroying the customer's property. It was therefore decided to try one ring as a test for the following procedure after stress relief:

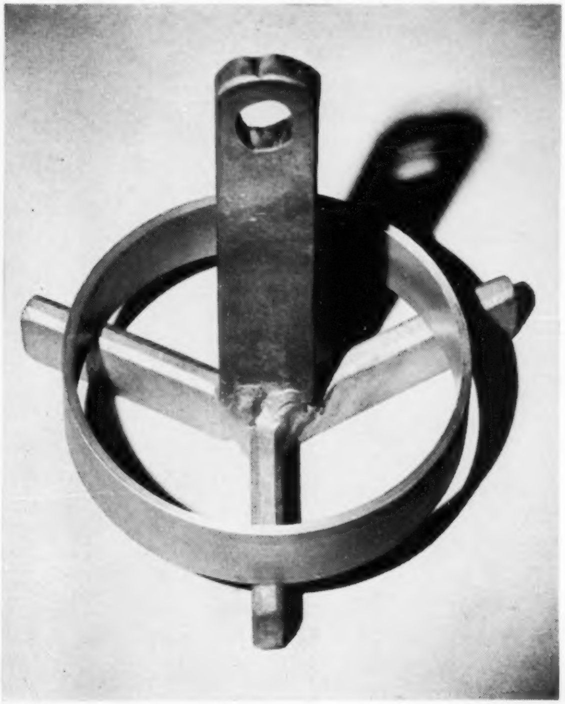


Fig. 3—Support fixture and ring as used for immersion in salt bath.

1. Stress Relieve at 1200°F.
2. Preheat in neutral salt at 1200°F 10 minutes.
3. Heat in neutral salt at 1500°F 10 minutes.
4. Quench in salt at 600°F hold for 20 minutes.
5. Air cool and temper at 750°F for 1 hour.

The dimensions before and after treatment were measured and found to remain within the limits specified. The hardness, however, was a uniform 54-56 Rockwell C on all surfaces, too high for the specifications of 45-49 Rockwell C. After tempering at 750°F for 1 hour the hardness was within the proper range and the dimensions remained within specification limits.

These results showed good promise but as a matter of experiment the procedure was changed by quenching another ring at 750°F instead of 600°F and held for 20 minutes. Unfortunately, although the dimensions were again within limits the hardness in the as-quenched condition was only 42-44 Rockwell C, several points below requirements. This ring was put aside untempered for correction at some later date. The balance of the rings were subjected to the original treatment and the average variations are noted in Table I.

It is interesting to note that the eccentricities, .0026" before treatment to .0045" after, seem to indicate that the rings have a tendency to grow about .0028" on an overall average. This might serve as a good indication of what to expect in other similar instances.

Three days later the ring mentioned above quenched at 750°F and held for 20 minutes was subjected to hardness test and found to have age hardened to a 45-46 Rockwell C without noticeable dimensional change. Careful and double checks were made by different inspectors on different Rockwell machines both before and after the aging.

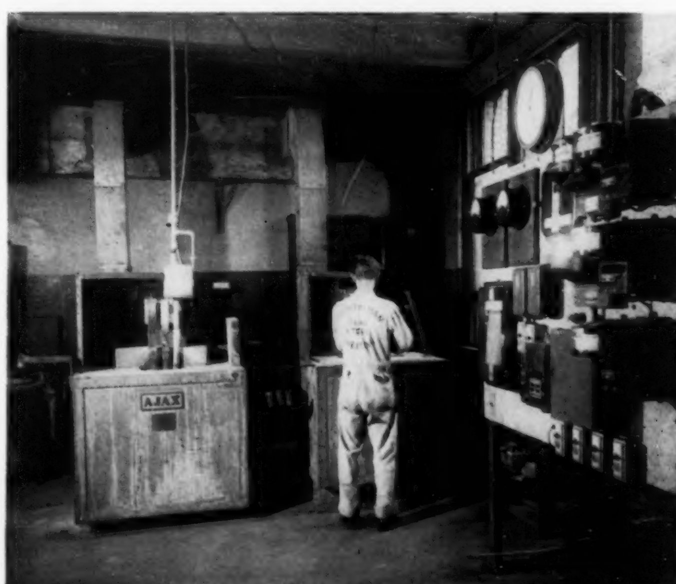


Fig. 2
Battery of Ajax Salt Bath Furnaces of the type used for the treatment of the proving rings.

Engineering Properties of Iron Castings Can Be Improved By Heat Treatment*

by C. E. HERINGTON

One of the most useful and possibly basic materials of construction in engineering components in the past has been cast iron. Cast irons have received a tremendous amount of attention from research workers in this last decade and we now find that they have not fallen into discard as has been predicted but have actually been produced in larger and larger tonnages. This is because of their characteristics in engineering construction and the comparative ease with which they can be produced and the tremendous improvements that have taken place in their manufacture and control and resultant properties. In fact one would be quite safe in stating that the modern controlled cast irons as produced today bear little or no relationships to the cast irons some ten years ago.

At one time, the engineer would not consider using any type of cast iron for a highly stressed component and, in fact, his lack of confidence in the material was such that the safety factors used in design often prohibited its use because of the terrific weight involved. Today, however, these safety factors have been reduced considerably in so many instances that modern cast iron is being used extensively in cast crankshafts (Fig. 1) for diesel and other type engines, pressure work, die manufacture, presses, mining equipment, etc.

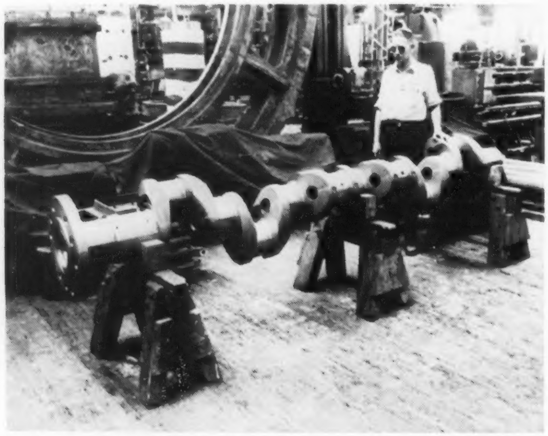


Fig. 1 — Typical Meehanite® Crankshaft produced for a 600 h.p. Diesel engine.

Changes in design made to increase efficiency or reduce machining costs are more readily accomplished with castings. For example, when a unit requires steam, air or water passages within the part, castings can meet these demands most efficiently even in cases of intricate design. Steam heated dies, water-cooled cylinders, diesel engine heads may be cast successfully and with an assurance of uniform density and solidity. The Meehanite quenching dies (Fig. 2) shown here were used to hold steel airplane propeller blades during a quenching operation. The dies were cored to allow the circulation of cooling water to flow through them.

Fig. 2 — Quenching Dies used in Heat Treating Steel Propeller Blades. The dies are cored to allow the internal circulation of water.

One of the features of the manufacturing techniques applied in the production of Meehanite castings is the ability to control the weakening influences of sectional changes and so regulate the metal in relation to the casting section that the engineering properties required are achieved uniformly. These techniques have been devised to permit accurate control of the structure of the solidified metal and it is this control of structure, not just chemical composition, which results in an equal control of the mechanical characteristics of the casting.

To understand the difference between Meehanite metal, ordinary cast iron and cast steel, it is necessary to examine some factors which influence the mechanical and physical properties of these materials.

The composition and structure of ordinary cast iron is, more or less, indeterminate and for this reason it is frequently not suitable for the high standards set in modern engineering practice. During solidification in the mold, cast iron becomes a mechanical mixture of

* *Adapted from the December, 1950 "Materials & Methods" article of the same title.*

graphite in a base matrix consisting of a number of constituents. The flakes of graphite in the matrix, are in reality thin saucers which occur in all planes and intersect one with another to form continuously interlocking structures through which fluids can seep even at normal low pressures. The flakes lie at all angles and in all directions and in the softer grades of gray cast iron, the graphite occupies from 10 to 13% of the volume of the casting.

(Fig. 3) is a graphical representation of the distribution of graphite in ordinary cast iron (left), and Meehanite Type GA (right). From this may be judged the effect of the continuous interlocking form of the graphite structure upon the mechanical properties and solidity.

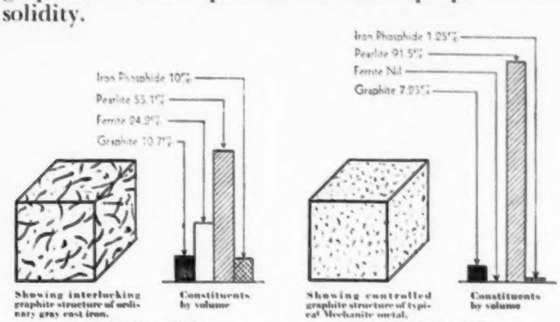


Fig. 3 — Graphical representation of what is achieved through accurate control of graphite structure within a metals matrix. Note variation of other basic constituents.

Note the difference which results from the control of the size and shape of the graphite as achieved in a Meehanite casting. These controls are achieved through careful regulation of raw material charges and special processes which predetermine matrix constitution and graphite shape and quantity.

As a result of these structural controls and the uniformity which is achieved by them, Meehanite castings have shown outstanding reactions to the various standard forms of heat treatment, and they may be fully hardened by various quenches and draws, and in addition may be subjected to flame hardening for local or surface characteristics.

Tensile strengths above 75,000 psi and Brinell hardnesses up to 500 may be achieved by oil quenching from 1600°F while a flame hardened surface will approach 600 Brinell with a depth of case from 1/8" to 3/16". In addition to the values illustrated, toughness is substantially increased with the obtainment of Charpy impact values above 10 ft. lb. if the material is subjected to drawing or tempering at about 750° for several hours. As a result of these sharp improvements in design and engineering characteristics, there has been a great deal of investigation with regard to the effect of heat treatments of Meehanite castings and the possible new applications which might be developed.

Because of the structural constitution of these materials, heat-treated castings may result in substantial cost savings, improved production efficiency and, of course, increased service life.

Much research over the years has been devoted to six basic heat treatments which are commercially applicable, and considerable work has been done to establish the so-called "critical" temperature range as far as Meehanite metal is concerned.

Maximum uniformity of structure as described before is always important else the effects of any heat treatment may be partly nullified. For these reasons if at all possible, the foundryman should know in advance if a casting is to be heat-treated by any method, and in Meenanite foundries when this is established special efforts are made to achieve a material of density and purity with particular effort to eliminate free ferrite. Of course, too, graphite flake size and distribution are also regulated.

It is, of course, recognized that heat treatment does not turn a poor casting into a good one.

In heat treatment, it is the matrix or basic mass of the casting, generally about 9/10 of its volume, which is altered by the process. After pouring an iron casting and as the casting solidifies, the matrix is made up of a solid solution of carbon in iron. As soon as the "critical" is reached this carbon begins its separation from the matrix in the form of iron carbide. The resulting structure, pearlite, actually is made up of alternate plates or iron and iron carbide. It appears that the change is completed at the lower end of the critical range and as the casting further solidifies no other structural change takes place. (Fig. 4) illustrates this

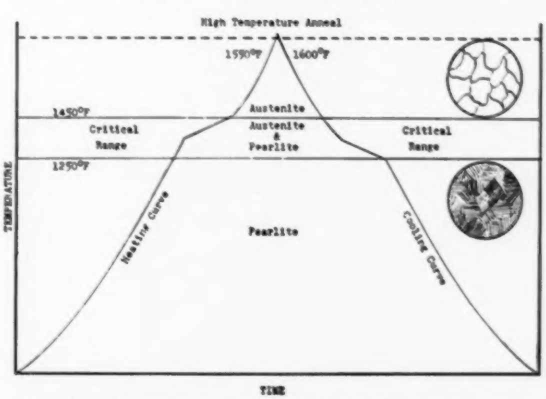


Fig. 4 — Heating and Cooling Curves of Meehanite Metal as related to critical range and structure.

change. Note that the "critical" is indicated between 1300°F and 1450°F. The exact position of the range naturally depends upon the type of Meehanite metal (either low or high carbon), whether the casting is being heated or is cooling; and finally the rate of heating or cooling.

The graphite flakes have been omitted from the illustration since they are unchanged by these particular procedures.

Editor's Note:

The second and final installment of this article will appear in our next issue. Six types of heat treatments and how they are applied to Meehanite castings will be described.

Economical Methods for Production Hardening

Part II

Editor's Note:

CORRECTION PLEASE:

Due to a misundersatnding, the first installment of this article carried an introductory statement that this material is a condensation of a panel discussion held "during a joint meeting of Metal Treating Institute members and the American Society for Metals." The meeting was, in fact, one of the regular panel sessions of the American Society for Metals, efficiently arranged and organized by Editor Thum of Metal Progress. Metal Treating Institute members participated only to the extent that its members were cordially invited to attend, and one of them, Horace Knerr, acted as Chairman of the meeting. We regret this error.

As stated before, Mr. Thum prepared the abstract and has kindly given us permission to publish it in "Metal Treating."

Leland—Apparently the gentlemen before me have had some sorry experiences in certain heat treating operations that caused them to consider other processes. Sometimes a metallurgist compares the old inefficient method with a new specialized process, and says "This will get me out of trouble quick!" Quite often the picture can be changed by looking at the old process twice, full in the face, and correcting a lot of difficulties involved there.

Now one of the characteristics of older heat treating operations was the batch-type furnace. It still has wide applications and definite advantages, as Mr. Bancroft will undoubtedly tell us later, and I will second him, especially in carburizing jobs where infiltering air is almost impossible to exclude in continuous furnaces. However, in mass production the batch-type furnace requires the best of design else it is a labor-eater; long ago the continuous furnace was invented, where a steady stream of work is pushed into one end and comes out the other end properly heated. Where there is mass production, continuous processes beat batch processes any day. I merely want to mention here that induction and flame hardening hold to the old way of doing a thing one at a time, and thus must have large collateral advantages to warrant their use in mass production unless completely automatic handling fixtures can be devised at reasonable cost.

A second characteristic of time-honored heating processes is the unwanted reactions between hot metal surface and hot atmosphere. In other words, the scale nuisance and soft surfaces from "decarb." Induction heating dodges this by its very short cycle, but the tendency is still there. Flame hardening is not so fast but it bathes the metal with a more-or-less protective flame—or at least a flame that excludes most of the atmospheric oxygen. Salt baths, properly compounded can be really protective—a bow to Ernie Bancroft at my left, here. But I am sure that one of the best helps that the heat treater has had in the field of mass production is knowledge of the correct atmospheres for heating parts to be hardened, tempered, or annealed, and the development of means whereby large volumes of carrier gas can be made at low cost and with relatively little difficulty. In any area today where natural gas is available, it can be endothermally cracked in air at about 1800°F. in the presence of a catalyst, and produce 1000 cu. ft. of carrier gas for approximately 25c. In a reasonably good furnace chamber, 1000 cu. ft. will process well over one ton of steel—sometimes as high as 3000 lb.

Now that's not very much to pay for eliminating scale, and a whole train of associated savings that are so well known that their repetition would be tiresome. Together with a cheap fuel and cheap atmosphere, there has been an improvement in mechanical handling devices that allows an operator to handle quite a large volume of steel. A ton an hour is not at all out of reason. Contributing to that has been clever design of holding fixtures so the load in the furnace is parts, not circulating heat resisting alloys. You want to heat treat *parts!*

So much for the clean hardening jobs. If you have carburizing to do, merely add a little carburizing component with the carrier gas; methane is a very potent carburizer, and 10c for enough gas for carburizing a ton of parts is well within the limits. If we desire to dry cyanide to obtain a file hard surface on oil quenched parts—light parts—about 70c per ton for ammonia is required in addition; that totals about \$1.00 per ton of steel required for the atmosphere gas (which of course does not include the fuel for heating).

Many of the above points are illustrated in the cam shaft job shown in Fig. 3. This particular unit has a load of approximately 5000 lb. of shafts. The shafts are supported by fixtures hanging from the furnace

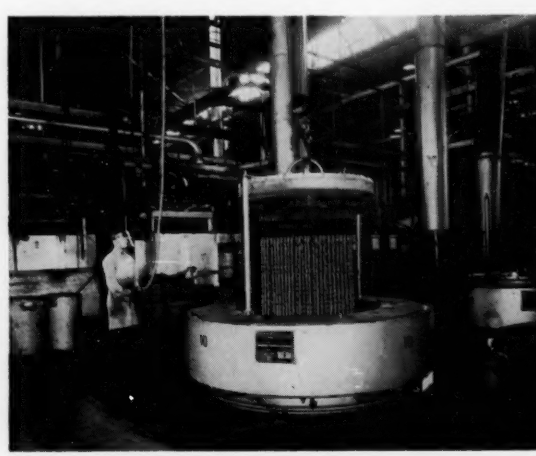


Fig. 3 — Loading Camshaft Furnace

chamber cover. Each fixture weighs 12 lb. Supported on that fixture are eight camshafts weighing $18\frac{1}{2}$ lb. apiece. That gives us a net load of about 80% of the total load, which is about as far as you can go, I believe. The operator on that job handles mostly *parts*. In this particular installation we have eight units. One operator per shift handles all of them plus three other smaller units which produce 2000 rocker arm shafts per day. Averaged out that figures to a little over one ton of steel per hour throughout the day.

Chairman Knerr—Before you go to the next slide, Leland, will you outline the next operation following the one you illustrate.

Leland—The figure is either the loading or the unloading of a furnace. That load is carried by a hoist. The operator simply pushes a button and lowers it down into the furnace (or takes it out). Metallurgically it is a job requiring an extremely deep case, and consequently that operation is not very feasible on a continuous furnace. The cycle is about 20 hr.; this load is lifted out and put in a chamber for rapid air cooling and it is subsequently reheated for hardening. I might say in the air cooling we must cool that load down rather rapidly to prevent decarburization of slowly cooled parts in the center of the load.

Bancroft—Are the parts taken off the fixture, that is, separated for the hardening operation?

Leland—Yes, the parts are hardened in another furnace. Before I leave this thought, I want to say that the method of handling or supporting effects many economies in subsequent operations. I am referring to the cleaning of parts after heat treating, sometimes the straightening of warped parts and broaching or grinding to take care of the excess distortion you sometimes get.

Wilson—I would like to ask a question. Is it more economical to use a forged camshaft, carburized, than it is to use a cast shaft and flame harden the lobes of the cams?

Leland—I understand that long years ago, Buick engineers were looking forward to a better and cheaper way of making camshafts. In my experience, periodically, every six months or a year, the problem comes up: "Well, how can we cut the costs of camshafts?" Much study has been put on it. We have looked at induction hardening of a high-carbon steel; we have looked at flame hardening of a high-carbon steel; we re-examined our carburizing practice. Our latest analysis indicates that the most favorable way would be to use our forged shaft as at present, carburize it all over and then harden the required areas selectively. However, we haven't come to the point of doing anything about it as yet.

Chairman Knerr—I seem to observe a disposition from one in the audience to ask a question. What is it, sir?

Audience Questioner—How would that be better than an all-over job of hardening?

Leland—The difficulties are in straightening. It is rather a tough problem to straighten a hardened camshaft so that grinding allowance can be held to a very low figure. We have produced as much as 0.090 in. case on that shaft and after we have got through grinding we find that we do not have more than 0.040 in. left. That is the production and then the removal of 0.050 in. of case, that is not very reasonable. By localized hardening the shaft, you would only have to carburize to 0.050 in.

Audience Questioner—How about time?

Leland—We would undoubtedly lose time in the carburizing.

Questioner—And the machining cost?

Leland—The machining cost, whether we carburize and harden the shaft all over or carburize and selective harden would be about the same because the machining is practically all done before heat treatment. Of course, if you use a medium-carbon steel, your machining costs would go up over the SAE 1016. Also there would be an additional operation of either annealing or normalizing the forged shaft.

Chairman Knerr—Thank you very much, Mr. Leland. I have no doubt you could advance many other facts to support your principal contention, that there's still plenty of life in the old heat treating operations. We all know that Flint is the place to go to see the most advanced furnace work. However, I must now ask Ernest Bancroft of Pratt & Whitney to tell us something about salt baths. Mr. Bancroft.

Bancroft—When we first started using salt baths, about seven years ago, we did it for a very specific reason, to heat the molybdenum-type of high speed toolsteel without surface decarburization. We did not think much about any collateral economies, but we have come to realize that they do promote economy in various ways.

To begin with, there is the factor of high productivity. One battery of furnaces consisting of preheat, high heat, and quench, puts out as much work as three of the older box-type horizontal set-ups each consisting of two furnaces and a quench bath. This is due to two factors—the faster rate of heating in molten baths and larger loads put into the furnace at one time. We have increased our batteries to two preheaters, one high heat, and one quench, because we find that it takes about four times as long to preheat a load of work as it does to bring it on up from there to the hardening temperature, so on that basis we have increased the production somewhat more.

Another very important feature is the reduction in the amount of straightening expense on slender tools. They can be handled vertically through salt baths and are not subject to the usual distorting and sagging influences. Another reason is that many long slender tools have a cutting section not more than half the total length; the rest is shank and neck, and only the cutting portion needs be heated and hardened. We estimate that the use of salt baths has reduced our over-all straightening costs by 75%. As an offshoot of this, we have reduced the amount of grinding stock provided on the tools, and reduced the tolerance to which tools can be straightened. Whereas formerly we might consider 0.005 run-out the maximum that could

be tolerated after straightening, we have reduced this to 0.004 in many tools. This also means that we can provide less stock for grinding, realize economy in grinding operations, and have a better balanced tool when we get through.

Chairman Knerr—Everybody on this panel seems to be in favor of less distortion. Maybe that's in line with the common saying "We're all against sin!" I will toss in the thought that vertical, atmosphere controlled furnaces avoid distortion and protect the surface as well as salt baths, will handle longer parts, and eliminate the waste of carry-over and the hazards of corrosion. Uniform heating of the piece is essential to avoid upsetting and consequent distortion. No matter how well the part is fixtured, if it gets all its heat from one direction, it's going to come out warped.

Mr. Lundquist—I agree with the chairman that uniformity in heating gradients and uniformity in imposed stress when the piece is heated for hardening helps to minimize warping. However, I would like to point out that selective heating limits the plastic metal to the outside and retains a much stiffer core. This support by the cool, stiff core in some ways can be compared to die or plug quenching.

Mr. Leland—We studied nitrate quenching for a production job on planetary gears. Here the problem was to keep distortion at a minimum. The run-out of teeth was required to somewhat less than 0.0003. At the outset these gears had been hardened in cyanide and oil quenched. The difficulty was in some extremely fine holes through the piece, toward the center, which became clogged with salt and were extremely difficult to clean. Labor costs also ran quite high. The second process was to dry cyanide in an atmosphere furnace and oil quench, but in mass loading we found that the distortion was way beyond what we could tolerate. The final solution was to fixture carefully, 68 to a load, heat in rotary hearth furnace with carburizing atmosphere, unload through a gas lock into an agitated nitrate bath, equalize and then cool in air. About the most interesting feature of it is the salt bath "furnace"; receiving 1200 to 1500 lb. of hot steel per hour it has to absorb and radiate a good many B.t.u.'s. Figure 4 shows that it is a furnace without any insulating material at all. To melt the cold salt there are two immersion heaters which consist simply of 3-in. black iron pipe. Once operating the bath is cooled by air passing through a bank of 44½-in. pipes that line the pot. Air is forced through them at the rate of about 1000 cu. ft. per min.

Chairman Knerr—When you get a handful of metallurgical experts together you come up with such curiosities as a furnace that is heated by a blast of cold air! However, I'm sure that Bancroft can say something more about salt baths for heating, rather than for cooling.

Bancroft—We have met the same difficulty as that mentioned by Mr. Leland. It is difficult to clean salt from small holes. Whether the salt is easily soluble in water or not, if it gets plugged into a small hole it doesn't rinse out. One way of overcoming that, if the parts have through holes is to pass wires through the holes; this plugs them almost completely. On withdrawal, while the salt is still molten, we shake the parts and the wires, even if loose, help to disturb the salt in the holes so that it drains out.

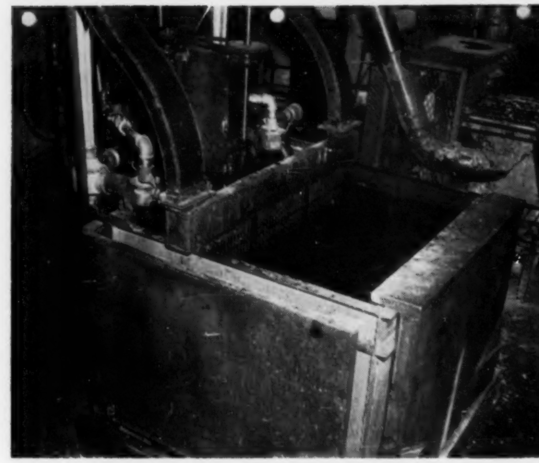


Fig. 4 — Nitrate Quench Bath

In view of what has already been said about surface protection, I might say that salt baths have their good points here, too. In a proper salt mixture, the molten bath absolutely prevents oxidation and scaling. The only thing that has to be removed is the salt itself and most of the salts used commercially are thoroughly soluble in water. It is not so easy to insure against carburization or decarburization—particularly decarburization. However this can be done in several different ways. Each manufacturer or user of salt bath equipment can work out a satisfactory procedure, and will find it fairly easy to control over a period of time. There are also possibilities in composite actions. One example is the so-called nitriding of high speed steel in liquid salt baths. Another example would be in the martempering by use of a high-temperature salt for heating and then quenching into a low-temperature salt, along the same lines as mentioned by Mr. Leland. Neutral salt baths lend themselves to this very nicely when treating either carbon or low-alloy steels or medium-alloy toolsteels.

Chairman Knerr—Let us hear now from the audience. We certainly haven't covered the ground so completely that there are no unresolved questions in your mind.

Audience Questioner—Mr. Wilson, is it primarily a matter of cost, that is, cost of heat treating, that dictates present practice in roller bearing races?

Wilson—This is a carburized, quenched and tempered part. It is a ring. Most of them are quite small, but some are very large—up to 6 ft. in diameter. I confess that my examples of carburizing practice were hand picked and I suppose that my colleagues on the platform did the same. I also believe that if these problems had existed in other shops, they no doubt could have been solved satisfactorily by other methods.

There is no one best solution for all conditions. I also think that very excellent jobs with induction hardening can replace some alloy steel with carbon steel—a lower cost material to start with. On the other hand there are some inherent disadvantages in selective hardening. For example, it becomes a difficult matter to heat the ring-shaped pieces on both inside and outside surface simultaneously by induction. If you take it in two steps—first the inside and then the outside—the cost becomes prohibitive in comparison with the carburizing process.

Lundquist—I see a man sitting out there who is also from Minneapolis. He works for Northern Ordnance, and they are doing a ring hardening job over there that is somewhat different from Timken's practice just outlined by Ralph Wilson.

Russell Lauderdale—This particular job involves the hardening of all the wearing surfaces of a large roller path about 12 ft. inside diameter and with a 2 in. rectangular cross section. After conventional hardening we had much difficulty in grinding such a large ring to a 0.040-in. limit. Eventually we threaded the ring through an induction coil and progressively heated a narrow band of metal about 1/4 in. wide. Following almost immediately after the coil is a water quench of the ring. The fully-hardened surface extends to about 0.090-in. deep. When we come around to the initial starting point, we got a very narrow band that wasn't quite up to the hardness of the rest of the part. Ordinary distortion involved after hardening would be about 0.020 in. out-of-round, and change in average diameter of −0.009 in. We have to grind off about 0.015 in. on the surface.

Wilson—Knowing something about Navy inspectors, I am sure Mr. Lauderdale's roller path is quite adequate for the purpose intended. However, I am sure that the soft overlap at the beginning and end of the progressive hardening operation is unacceptable in roller bearing practice. Do you remember the reputation Harry McQuaid got about 25 years ago in correcting soft *spots* in hard surfaces—spots, not bands.

Audience Questioner—I would like to hear more about the idea of carburizing a low-carbon part completely and coming out with the equivalent of high-carbon steel.

Leland—It is a fairly common operation at Buick, especially on parts from bars that have a slightly decarburized "bark." We put the carbon back to where it should be by running the proper carburizing atmosphere in the hardening furnace.

Wilson—I can give an example of automobile clutch springs, originally made of sheet material, 0.057 in. thick, S.A.E. 1065. In order to accommodate the rather difficult forming, the sheets were cross-rolled to improve the grain, and were supplied over-gage to take care of decarburization in the spheriodizing anneal. So in addition to the extras in the purchase price, there was the spheriodizing anneal and the grinding. Alternatively, a comparatively low-carbon material could be bought as regular sheet, rolled just to size; there would be no spheriodizing anneal and no grinding to remove decarb. Through carburizing was substituted for those operations. (Hardening was common to both procedures.) In addition, the number of wasters decreased in the drawing operation. Finally, the company making these clutch springs believes that the uniformity of the product was much better when it is made of the low-alloy, low-carbon steel, fully carburized.

Chairman Knerr—There seems to be nothing new under the sun, only old things made better. Ralph's clutch bands remind us of the ancient way of making steel—cement bar or blister bar they called it—by packing wrought iron bars in charcoal and heating them for a week or ten days. One more question only, please.

Audience Questioner—Is there any difference in performance of a gear of the same surface hardness, depending on the hardening method used to get that Rockwell number?

Chairman Knerr—I would interpret that to mean—is there any virtue in increasing molecular activity—that is, the heat—by electrical current rather than by bombardment of fast neighboring molecules (hot surroundings)? Any volunteers for that hot potato?

Riegel—I think that perhaps I might throw a little light on that question by stating that the large final drive gear mentioned at the outset runs against an alloy pinion, carburized and hardened. It used to be that the gears wore out first. Now the pinions wear out first. Of course, you would expect that because they do more work, but actually we have records of bull gears that still show tool marks after 3000 hr. service, when the mating pinion already started to give.

Lundquist—I think, Glen, that that is not due to the method of getting the heat into the part when hardening. Is it not more likely that the old alloy steel gear, oil quenched and tempered, had a far less favorable distribution of compressive stresses locked up at the very wearing surface?

Riegel—That has a good deal to do with it. Furthermore we now have a case depth on the gear of about 0.125 in. as against 0.070 to 0.080 in. on the pinion.

There are many other factors, and I do not know of any differences in microstructure or performance that cannot logically be ascribed to such things as carbon content, alloy content, grain size, speed of quench, hardenability of steel, and resultant state of stress.

We do a lot of heat treatment in the various Caterpillar plants, and use all of the modern processes. We induction harden about 800 individual parts in production. Some of these show peculiarities that throw some light on the gentleman's question. We have pretty extensive equipment for hardening, full length, cold drawn bars. This is an induction setup in which there are four tandem sets of hardening, quenching and tempering operations. It gives us much more uniformly heat treated bars, and when these are cut into studs or tie rod of short lengths, the individual parts are of uniform physical characteristics, of high yield strength and good toughness. Formerly these bars were hot rolled and then heated in 20-ton loads in a con-

ventional furnace, and they warped so badly in heating that they were difficult to quench. Then they had to be straightened so that they could be pulled through the drawing dies.

Figure 5 shows the comparative physical characteristics of studs made from bars of the two histories.

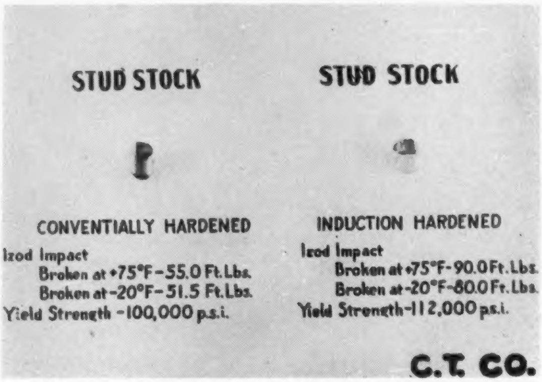


Fig. 5 — Comparison of Properties of Studs

The conventionally hardened material struggles oftentimes to make the appropriate minimum yield strength and was frequently inferior to the demand for 50 ft.-lb. Izod at –20°F. (That test uses a sharp notched specimen to intensify the degree of constraint.) On the other hand the induction hardened material produced easily and more uniformly a high yield strength, and certainly the notch toughness was immensely improved. Complaints about studs stretching in the shop and failing in the field diminished to the vanishing point.

Chairman Knerr—You must have some explanation, Glen, for the fact that the impact value went up so sharply on the stud stock, induction treated.

Riegel—The conventional heat treatment was rarely successful in obtaining as much as 50% martensite in the as-quenched structure, whereas we could get from 90% at the surface down to 50% in the center even into a 1½-in. bar. Therefore we had a very fine-grained martensite, uniformly tempered. I think that accounts for the difference in toughness.

Chairman Knerr—It is now time for a summary. It must be brief—perhaps like this: There is no magic in this, that or the other process. Any of them requires a large mixture of intelligence. Likewise the cost of hardening a part or a pound is only a portion of the cost. Successful heat treatment must be integrated with operations before and after. The ideal is a part that is good enough for the purpose intended; one that will satisfy the user, and warrant his good will. Achieve that with a minimum of cost—*total* cost—and you are a successful metallurgist. We thank you very much for your attention, and that concludes the session.

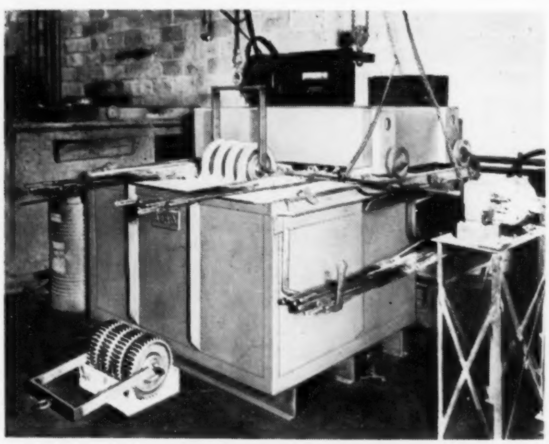
THERMO-COUPLETTES . . .

Liquid Flame Hardening

To the best of our knowledge, the following case history represents the first use of a salt bath for "flame hardening" gear teeth. The credit for adopting the salt bath for this method of selective heat treating is due Mr. William F. Sorenson, Metallurgist of Yale & Towne Mfg. Co., Philadelphia.

Many different types of gears are used in Yale & Towne electric trucks and hoisting equipment, and one of the items which is now being "liquid flame hardened" is the slow speed gear for the 5-ton Cable King Hoist.

This particular gear is of SAE 4140 steel, normalized and annealed to Bhn 195-200. The gear blank is rough cut and then hardened all over to Rc 36, sand blasted, splined to finish size and the face and teeth machined. The next step is to harden the gear teeth without disturbing the finished inside diameter.



Four gears (partially immersed) are revolved in their Ajax carburizing bath, operating at 1525°F., for 7 minutes at 60 RPM. The depth of immersion is approximately 1 in. The gears are then oil quenched at 140°F. The hardness on the teeth is Rc 50-52.

The inside diameter and the outside dimensions of the gear are unchanged by this salt bath hardening method. This was not the case when other methods were used. Distortion was approximately 0.005 in., the inside diameter was tapered and quenching stresses were excessive resulting in a high percentage of rejects.

There is no scaling since the salt forms a thin, protective film around the teeth, sealing them from contact with the air. Induction and conventional flame hardening were first tried but the scale which resulted made it necessary to sand blast the gears lowering their wear resistance.

Hardness of the gears is uniform and symmetrical enabling them to withstand the high stresses imposed on them in service. There is a definite advantage to be gained by using a carburizing bath since some carbon and nitrogen are picked up on the surface of the gear teeth. This results in greater wear resistance in service.

From the fine results achieved in this instance, it is expected that the new "liquid flame hardening" technique will find expanding industrial application.

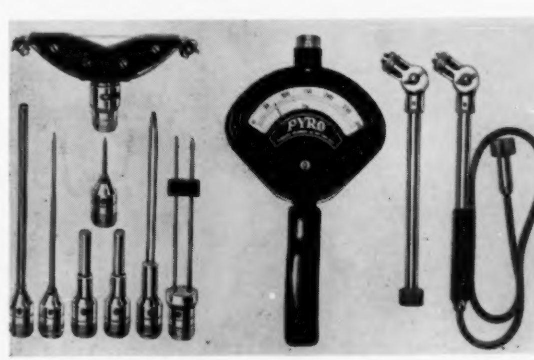
Reprinted From
"TIPS AND TRENDS"
Through Courtesy of Ajax Electric Co.
Philadelphia, Pa.

Pyro Surface Pyrometer

To meet the ever-growing requirements of industry for the quick and accurate measurement of surface and sub-surface temperatures, Pyro has designed a completely new, all-purpose Surface Pyrometer adaptable to innumerable problems arising daily in heat treating plants and laboratories.

The new instrument is mounted in a special rubber cushioned steel housing. Not only is it immune to external magnetic influences but it is also dust, moisture and shock-proofed. It has a large 4¾" direct reading indicator calibrated in five standard temperature ranges. The automatic cold and junction compensator, furnished as standard equipment, assures accurate and true temperature determinations at all times.

Any one or more of a selection of eight types of thermo-couples may be secured with this instrument together with either a rigid or flexible extension arm. These thermo-couples and extension arms are all interchangeable without the use of tools and without adjustment or recalibration. Information regarding special applications such as permanent and continuous temperature measurements and internal press temperatures, or between sandwiches under pressure will be furnished gladly upon request.



Pyrometer Instrument Co., Inc.
Bergenfield, N. J.

(Please turn to page 20)

Manufacturers' Literature . . .

The literature listed below contains information of interest to heat treating organizations. For your copy write direct to the manufacturer and be sure you mention seeing it reviewed in "Metal Treating".

New Catalog Section Describes Homocarb Furnace With Controlled Atmosphere

To show how heat-treaters can now have full control not only over temperature and time, but over furnace atmosphere in such diverse applications as hardening, annealing, normalizing, carbon restoration, and carburizing to controlled surface carbon content, Leeds & Northrup Company has just published an illustrated, 4-page catalog section (Cat. T-623, Sec. 1). It describes the new Series H Homocarb Furnace Equipment, with recently-developed Microcarb Control, which continuously and automatically regulates carbon content of the Homocarb atmosphere.

This publication describes how, with Microcarb Control, the heat-treater can automatically control the carbon content of the surface of the steel being treated to any selected point in the range of 0.15% to 1.15% carbon. A center-spread illustration displays the complete Series H Equipment: Micromax Temperature and Microcarb Atmosphere Control Panels, and the Series H Homocarb Furnace. Enlarged views emphasize particular design features essential to the expanded application of the Homocarb method.

A complete listing of specifications is given for the units comprising the temperature and atmosphere control systems, and for the Series H Homocarb Furnace. In addition, a tabular listing of the work-space dimensions facilitates a choice of suitable furnace from the wide range of sizes available.

A copy of the Cat. T-623, Sec. 1 will be sent upon request. Address Leeds & Northrup Company, 4934 Stenton Ave., Philadelphia 44, Pennsylvania.

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Shaft Straightening Attachments

A four-page folder, Bulletin 396, describing standard models for production straightening of shafts, tubes, bars, etc. Bulletin contains complete specifications and illustrations in detail of accessories which may be applied to power presses for straightening operations. Write to General Manufacturing Company, 6430 Farnsworth Avenue, Detroit 11, Michigan.

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Thermocouples and Accessories

A new Catalog No. 5 entitled "Thermocouples" has been published by Arklay S. Richards Co., Inc., Newton Highlands 61, Mass. The catalog contains 16 pages, is well indexed and provides complete catalog descriptions of thermocouples, protection tubes, wires, insulators and accessories.

* * * * *

New Heavy-Duty Portable Gas Torch

Bulletin No. 1070 describes a new line of portable gas torches offered by Hauck Manufacturing Co., 124-136 Tenth Street, Brooklyn 15, N. Y. The torches are designed to operate with compressed air at 40 psi and generate heat at 2700°F. flame temperature. Adaptable for heating, straightening, bending, expanding, preheating, etc.

* * * * *

Basic Guide to Ferrous Metallurgy

Tempil Corporation, 132 West 22nd Street, New York 11, N. Y. publish a well prepared and helpful wall chart described as a "Basic Guide to Ferrous Metallurgy." The wall chart provides a color guide to temperature ranges of ferrous materials and lists some well written metallurgical definitions. Specific temperature ranges for various heat treatments are also charted over the color panel.

* * * * *

Dry Cyaniding

Latest developments in the modern dry (gas) cyaniding process, with equipment and its applications, are presented in a new 4-page bulletin. Both liquid quenching and slow cooling and their applications are described. Surface Combustion Corporation, Toledo 1, Ohio.

* * * * *

Furnaces, Gas Fired

Blueprints available for layout of 20mm.-37mm.-40mm. and larger shell cases, providing compact and efficient heat treating facilities with most economical investment. Despatch Oven Company, 619 S. E. 8th Street, Minneapolis, Minn.

* * * * *

Furnaces, Salt Bath

A 4-page bulletin describes construction and operating characteristics of new salt bath furnace employing totally submerged electrodes. Well suited for heat treating in temperature range 1700 to 2400°F. Ajax Electric Company, Inc., Philadelphia, Pa.

* * * * *

New Quenching Oil Additive

The J. W. Kelley Company has published an 8-page brochure that describes a new additive which they have developed for their Beacon Quenching Oils. It tells in detail how low priced, more readily available carbon steels can often replace alloy steels by quenching them in Beacon Quenching Oils with QUENZINE added. Complete specifications are included. Their carburizing compounds, heat treating salts and rust preventives are also discussed. For a free copy of this booklet, "The Quenzine Story," write to, The J. W. Kelley Company, 3401 West 140th St., Cleveland 11, Ohio.

Report of the Committee on Policy with Regard to Liability of the Heat Treater

HOWARD N. BOSWORTH, *President*
Detroit Metal Treaters' Assoc.

Editor's Note:

Some time ago the Detroit Metal Treaters' Association, whose membership consists of commercial heat treating plants in and about Detroit, Michigan, appointed a committee to study the problem of product liability for the commercial heat treater. This report was presented before a meeting after considerable study, simply as a suggestion of policy which might be followed. It does not represent Institute policy. This subject, of course, is highly controversial from both an individual and legal standpoint and it suggests that a series of short articles could be run regularly setting forth the opinions and practices of various Institute members. Just drop us a letter giving your ideas.

Your committee consisting of Carl Anderson, Jim Thompson, Gordon Wright, Sig Servinski and Lucas Miel, met on April 19, 1950.

After a thorough discussion of many of the factors involving the liability of a commercial heat treater, it was decided that these points should be submitted for consideration.

1. Losses being considered are only those that occur during or are caused by the heat treating process.
2. The commercial heat treater is responsible for such losses only if they are caused by factors within the control of the heat treater.
3. The commercial heat treater is not responsible for such losses which result from causes within the control of the customer.
4. The commercial heat treater is not responsible for such losses which are the result of risks inherent in the process of heat treating.
5. The greatest amount the commercial heat treater will pay any customer is the sum of the time and material of the customer at the time of the loss. Specifically, in no circumstance will a burden be paid in addition to time and material. Any compromise up to the total of the time and material is permitted under special circumstances.

The following general discussion will summarize the reason for presenting these points.

First of all, we must limit losses being considered to those that occur during or are caused by the heat treating process. This covers the entire time in our possession. But, it does not include losses caused by subsequent processes of the customer.

Secondly, the broad question analyzed was:

"When is the heat treater responsible for a loss that occurs during or is caused by the heat treating process?"

In answering this question, the committee reasoned that there are three different types of situations that can cause a loss:

1. Factors that are within the control of the commercial heat treater.
2. Factors within the control of the customer.
3. Factors that are considered inherent risks of the heat treating process.

The question of *when* the heat treater is responsible appears to be easily answered if the cause of the loss can be placed in one of these three categories.

POINT 1 — HEAT TREATER'S CONTROL

The heat treater is selling three items—Time, Temperature, Technique. Hence, the heat treater should be and therefore is responsible for furnishing these items as agreed. Therefore, the factors that are usually considered within the control of the heat treater are *time, temperature,* and *technique.* Technique is used in a broad sense to include the obligation to return the customer's property. Hence, if it is lost or dropped, the heat treater is responsible. If it is stolen or burned up in a fire, the question might arise as to whether the technique was proper.

POINT 2 — CUSTOMER'S CONTROL

Clearly, no commercial heat treater should be responsible for losses that are within the control of the customer. This would include such items as design of part, type and quality of material. Since the customer always specifies his own material and chooses the source for obtaining the material, the customer must be held responsible for losses resulting from faulty material. It is up to the customer to get complete satisfaction from its source of material.

POINT 3 — INHERENT RISKS

"Inherent Risks" of heat treating are usually classed as shrinkage, expansion, deformation and rupture. A reasonable degree of care must be exercised by the heat treater to keep these factors within reasonable bounds—that is, good technique—but, no commercial heat treater can guarantee that there will be no shrinkage or expansion. Likewise, no heat treater can successfully guarantee that the shrinkage or expansion will be held within a certain limit. The heat treater can only recommend and suggest, but, should not be bound by helpful recommendations or suggestions.

With respect to deformation and rupture, it must be recognized that there are losses due to deformation or rupture, the cause of which is faulty time, temperature or technique. Hence, the cause of deformation or rupture must be determined. However, if it is determined that the time, temperature, and technique of the heat treater was correct and still a deformation or rupture ensues which causes a loss (is not corrected in the straightening operation), then such loss must be attributed to "risks inherent in the heat treating process."

SUMMARY

To summarize, the committee feels that each loss should first be analyzed from the point of view of

determining whether the heat treater is responsible. In making this determination, the loss must be analyzed to determine whether it is:

1. Within the control of the heat treater.
2. Within the customer's control.
3. Risks inherent in the heat treating process.

If it is determined that the loss falls in category No. 1—within the control of the heat treater—then the heat treaters responsibility shall be to reimburse to the customer his direct labor, time and material up to the time of sending the work to the heat treater. In no event will the commercial heat treater be responsible for burden in addition to time and material.

The committee suggests that the entire membership analyze these points with a view to criticize in two ways:

1. State the things that are wrong with this conclusion.
2. State the arguments that support the conclusion recommended by the committee.

It is the committee's opinion that if all the commercial heat treaters have the same approach to the settling of a claim resulting from loss in heat treating, we will be able to eventually educate all of our customers to accept this statement of liability, which is considered fair and reasonable.

Reasons Why Burden Should Not Be Paid

1. The commercial heat treater is not a source of income to his customer but is on the contrary, an expense. The only source of income for the heat treater's customers is the customer's customer. Throughout the entire year, the heat treater's customer must get his income to pay all of his burden from his own customers. Anything he passes back to commercial heat treaters, must be eventually obtained back again by the commercial heat treater —or there will be no commercial heat treater. This is just saying that the commercial heat treater must make a profit on work done from his customer or he cannot remain as a heat treating source.
2. The customer usually does not have any additional burden resulting from a loss in heat treating. All the actual expense is his own time and material. In other words, the burden of the heat treater's customer continues on exactly the same. The actual loss to the customer is almost always the direct labor, time and material. (To add a fictional burden is really the making of a profit on the heat treater's misfortune).
3. The heat treater's charges for the service of heat treating is based on time and material in the heat treater's plant. It isn't related in any way to the value of the article heat treated. Any loss sustained and any credit issued for work is a loss to the heat treater. The minimum payment to replace the lost article for the customer is the most that should be paid. This is just another way of saying that since the heat treater's profit is so small in today's price structure, it is not possible to establish a practice of paying a customer's burden in addition to time and material.

Personal (cont.)

Quebec and spending some time at the famous Chateau Frontenac. During the trip they had a visit with Bill Bennett in Brattleboro, Vermont.

* * * * *

Fred Heinzelman & Sons Company have recently placed orders for two important pieces of equipment. After seeing the new small size Hydro-Finish Cabinet at the Metal Show and reading further about it in the November "Metal Treating," Page 10, an order has been placed for a unit. In addition they have also ordered from Baker & Company, Inc., Newark, N. J., a Nitroneal Generator, also described in November "Metal Treating," Page 19. The new generator will have a 500 cu. ft. per hour capacity and will be used in conjunction with a controlled atmosphere furnace.

* * * * *

J. W. Rex Company has purchased a Dow gas cyanide furnace which will give them a cyaniding capacity of 1000 lb. per hour. This is the first cyaniding equipment they have installed.

President Rex has also informed us that he installed a bonus and profit sharing plan effective December 1, 1950 which are along the lines of those discussed during the last Institute meeting in Chicago. At present the company employs about 60 people who will participate in the plan.

* * * * *

The American Society of Tool Engineers are holding their annual meeting in New York City March 15-17. During the sessions Mr. B. H. Marks and Mr. A. L. Gardner of the Pangborn Corporation will be presenting a paper on "Manufacturing Applications of Liquid Impact Blasting."

Fred Heinzelman, Jr., has been invited by the Program Committee of the ASTE to present a five-minute discussion of the paper during the meeting. Fred has accepted and will give a brief review of the many applications which they have uncovered for this equipment in their plant.

NEW MEMBERS

It is a pleasure to welcome to the membership ranks Mr. Earl P. Brane, President, Nerl Heat Treat Corporation, 1824 S. Franklin Street, South Bend, Indiana. The Nerl Heat Treat Corporation originally started in business in 1944 with three employees and seven furnaces in a building with 2100 square feet of floor space. Evidence of real progress is found in the fact that today they occupy a building with 7,000 square feet, employ fifteen men and have thirty-three furnaces.

We are happy to announce that Accurate Steel Treating Company, 2226 West Hubbard Street, Chicago, Illinois is also another new member. News reached us at the last minute and further details will be published in the next issue.

Each new member is another indication of the recognition of the value of group effort. Let each member set himself a goal for 1951 to get one new member.

DON'T FORGET TO MAKE YOUR PLANS FOR THE SPRING INSTITUTE MEETING AT THE HOTEL COLORADO, GLENWOOD SPRINGS, COLORADO, MAY 28-30, 1951.

LETTERS TO THE EDITOR

Dear Editor:

I have been trying for several weeks to write you with a few news items from Milwaukee. So here goes, first I want to report the death of Al Huber from Supreme Metal Treating and I will send you the obituary. Al had been sick several years and our group will sure miss him. He was a right guy.

The business will continue however, with Mrs. Huber retaining her interest and they have a son about 17 who is planning to continue the business after finishing his education which I under-

(*Please turn to page* 18)

Letters to the Editor (cont.)

stand will be Metallurgical Engineering.

Al's partner, Mr. Brerton will continue the operation as they have been in the past.

Wesley Steel Treating and Thurner Heat Treating both have made new Installations of Ipsen Furnaces which helps our Milwaukee district in maintaining its reputation for modern methods.

Business has been quite good here up to about 10 days ago and there now seems to be a slack period. Our customers we believe are now in between civilian and defense changeovers.

Robert Seger and Andy Olsen from Chicago Steel Treating were Milwaukee visitors, Dec. 5, and toured our various plants. We all had a nice day with these two very good Chicago members.

I have been thinking of some way us Heat Treaters could rig up a clearing house for used or no longer needed Heat Treating equipment. I know we always have several items that don't fit us any more and yet could be used by another plant, and we are always looking for other type equipment that may be idle in some other plant, could you do something about this situation.

I have just received your letter regarding the committee I am to serve on and shall be happy to help wherever I can.

Yours very truly,
Metal Treating, Inc.
C. F. GRAHAM

(The Milwaukee district always makes news, showing progress and cooperation. Mr. Graham's suggestion for an information clearing house on equipment is excellent. Let's start it by sending to the Institute offices a notice regarding any usable equipment you might want to sell or swap. We will publish it and also inform other members.)

Dear Editor:

Just received the November issue of "Metal Treating" and want to congratulate you on the progress you have made.

You will probably improve the magazine, but even if future issues are no better, we still have a journal we can feel proud of. You may even have trouble keeping up with the standard you have established with the November issue.

I would anticipate that your biggest problem would be to snap the members out of the lethargic "Let George Do It" attitude which most of us are inclined to assume and get them to contribute an article or something they are doing in their own plant that might be of interest to other members. Other factors than laziness, that probably enter into the picture are the fear that if a man tells about something he has done, he may help a competitor, and on the other hand very often a man tends to belittle his own accomplishments and not realize what he has done that if written up would help another member.

If each of the sixty members furnished you with one article per year, you would have five contributions per month and your time could be devoted to editing.

I don't quite understand why I have the temerity to make any suggestions, since with your experience in association work you realize what the problems are and undoubtedly have at least a partial solution to them.

I do want to add that I was pleased to see three contributions from members in the November issue.

Ray Sault has a very excellent article on "Customer Relations." I am going to see that everybody in our organization that can read has an opportunity to absorb these ideas. You can always count on good old (and I don't mean aged) Ray to do his part, and do it intelligently.

The article by Fulton is excellently written and covers the solution of an unusually tough problem. The article by DePoy, while not of direct interest to us, since we use no salt baths except the cyanide type, gives the complete data of a very painstaking series of tests, and should be of interest to all users of neutral salt baths.

We have in use in our plant a unique loader for continuous furnace that has been developed by a local company. We have helped them work the bugs out of this device and it appears to be perfected to the point where we will be ready shortly to send you a description of it for publication if you see fit.

On Page 5, you suggest that the members of the Institute spend $200,000 monthly for supplies, fuel and equipment. You may have some data, on which you based these figures or you may have tried to make a shrewd guess, but my calculations seem to indicate this sum to be far too modest.

Using the 1949 sales report, increasing these figures by a percentage somewhat less than our own increase and further correcting for a 40% increase in members, at least three of which have very high sales, I would guess that our members' sales are running close to $1,500,000 per month. Our own expenditures for fuel and supplies range from 18% to 25% of our sales. Using 20% would indicate $300,000 monthly for fuel and supplies alone. At the rate of $20,000 per year per member for new equipment, a figure which is probably low, gives us $1,200,000 per year or $100,000 per month for equipment. This would make a total of $400,000 per month for fuel, supplies, and equipment.

Yours most truly,
Commonwealth Industries, Inc.
CHARLES G. HEILMAN, Pres.

(Previous sales figures quoted in "Metal Treating" were based on 50 members having a gross sales of ten million dollars. This is certainly a helpful letter and many thanks Mr. Heilman).
—The Editor

Thermo-Couplettes (cont.)

Cost of Quality Always Accepted

The other day we received 6 small High Speed Steel pieces from a firm who had not previously sent us any work. The instructions were to harden and temper to 63 Rockwell C. There was the added note, "This is a trial order—more business will follow if these are satisfactory."

We completed the job and sent them a bill for $3.50. Immediately we received a phone call that these pieces would come through in 500 or 1000 lots but not at the rate of $3.50 for 6 pieces! After proper explanation this billing was accepted. We then elicited the information that the customer had been paying 3c each after we had quoted him 6c each.

After further conversation about the advantages of salt bath treatment for High Speed Steel, it developed the parts had not been receiving this treatment and furthermore that there had been no uniformity of hardness. He agreed that when he was paying 3c each he was not getting 100% good pieces, and in addition he had found that the six sample pieces gave him increased tool life during production over those previously treated.

We proceeded with the lot of 500 at 6c each. The customer is well pleased, reporting 100% good parts and better production from each tool.

Always give the customer quality work. Then you can justify your price even though it is double the previous cost.

Fred Heinzelman, Senior

" I UNDERSTAND YOU STRESS-RELIEVE THINGS "

THE METAL TREATING INSTITUTE

ASSOCIATION OF MASTER CRAFTSMEN

THE MEMBERSHIP - 1951

Accurate Steel Treating Co.
2226 W. Hubbard Street
Chicago 12, Illinois

Ace Heat Treating Co.
611 Grove Street
Elizabeth, New Jersey

American Metal Treatment Co.
Highway 25 and LaFayette Street
Elizabeth, New Jersey

American Steel Treating Co.
P. O. Box A
Crystal Lake, Illinois

Anderson Steel Treating Co.
1337 Maple Street
Detroit 7, Michigan

B-M Heat Treating Co.
220 Clifford Street
Newark 5, New Jersey

Bennett Steel Treating Co.
246 Raymond Boulevard
Newark 5, New Jersey

Chicago Steel Treating Co.
333 North California
Chicago, Illinois

Cincinnati Steel Treating Co.
Wooster Pike & Mariemont Avenue
Cincinnati 27, Ohio

Commercial Metal Treating, Inc.
89 Island Brook Avenue
Bridgeport 6, Connecticut

Commercial Steel Treating Co.
1225 Marquette Avenue
Cleveland 14, Ohio

Commercial Steel Treating Corp.
6100 Tireman Avenue
Detroit 4, Michigan

Commonwealth Industries, Inc.
5922 Commonwealth Avenue
Detroit 8, Michigan

Cook Heat Treating Co., of Texas
6233 Navigation Boulevard
Houston 11, Texas

Cook Heat Treating Corp.
5934 Alcoa Avenue
Los Angeles 11, California

Dayton Forge & Heat Treating Co.
2323 East First Street
Dayton 3, Ohio

Dura-Hard Steel Treating Co.
2333 West Deming Place
Chicago 47, Illinois

Eklund Metal Treating, Inc.
721 Beacon Street
Love Park, Illinois

Getchell Steel Treating Co.
1106—10th Avenue S. E.
Minneapolis, Minnesota

Greenman Steel Treating Co.
284 Grove Street
Worcester 5, Massachusetts

Harris Metals Treating Co.
1745 Taylor Avenue
Racine, Wisconsin

Fred Heinzelman & Sons Co.
138 Spring Street
New York 12, New York

Alfred Heller Heat Treating Co.
391 Pearl Street
New York 7, New York

Hushek Metal Processing Co.
1536 West Pierce Street
Milwaukee, Wisconsin

Industrial Steel Treating Co.
600 Fallon Street
Oakland 7, California

L-R Heat Treating Co.
680 South 16th Street
Newark, New Jersey

Lakeside Steel Improvement Co.
5418 Lakeside Avenue
Cleveland 14, Ohio

Lindberg Steel Treating Co.
222 North Laflin Street
Chicago 7, Illinois

Maryland Tool Company
111-13 Hollingsworth Street
Baltimore 2, Maryland

Metal Treating & Research Co.
651 Sherman Street
Denver 3, Colorado

Metal Treating, Inc.
720 South 16th Street
Milwaukee 4, Wisconsin

Metallurgical Control Labs.
2226 East Lake Street
Minneapolis 7, Minnesota

Metallurgical Service Co.
1020 East Michigan Street
Indianapolis 2, Indiana

Metlab Company
1000 East Mermaid Lane
Philadelphia 18, Pennsylvania

Metro Heat Treat Corp.
466 Broome Street
New York 13, New York

O. T. Muehlemeyer Heat Treating Co.
1531 Preston Street
Rockford, Illinois

Nerl Heat Treat Corp.
1824 So. Franklin Street
South Bend 23, Indiana

New England Metallurgical Corp.
9 Alger Street
South Boston 27, Mass.

Ohio Heat Treating Co.
1100 East Third Street
Dayton 2, Ohio

Pearson Industrial Steel Treating
5757 Ogden Avenue
Chicago 50, Illinois

Perfection Tool & Metal Heat Treating Co.
1740 West Hubbard Street
Chicago 22, Illinois

Pittsburgh Commercial Heat Treating Co.
49th Street and A.V.R.R.
Pittsburgh 1, Pennsylvania

Porter Forge & Furnace, Inc.
74 Foley Street
Somerville 43, Massachusetts

George H. Porter Steel Treating Co.
1265-71 East 55th Street
Cleveland 14, Ohio

Precision Heat Treating Co.
216 William Street
New York 7, New York

Queen City Steel Treating Co.
2980 Spring Grove Avenue
Cincinnati 25, Ohio

J. W. Rex Co.
834 West Third Street
Lansdale, Pennsylvania

Stanley P. Rockwell Co.
296 Homestead Avenue
Hartford 5, Connecticut

C. U. Scott & Son, Inc.
1510 First Avenue
Rock Island, Illinois

Fred A. Snow Co.
1942 West Kenzie Street
Chicago 22, Illinois

Spindler Metal Processing Co.
2338 Mead Street
Racine, Wisconsin

Supreme Metal Treating Co.
4440 West Mitchell Street
Milwaukee 14, Wisconsin

Syracuse Heat Treating Corp.
1223 Burnet Avenue
Syracuse 3, New York

Thurner Heat Treating Co.
809 West National Avenue
Milwaukee 4, Wisconsin

Vincent Steel Process Co.
2424 Bellevue Avenue
Detroit, Michigan

Wesley Heat Treating Co.
825 South 21st Street
Manitowoc, Wisconsin

Wesley Metal Treating Co.
2320 Mead Street
Racine, Wisconsin

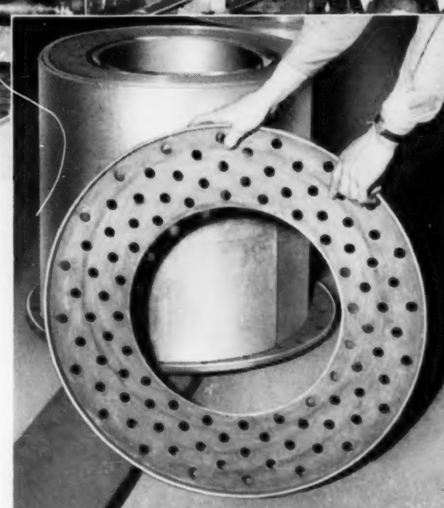
Wesley Steel Treating Co.
1301-1403 West Pierce Street
Milwaukee, Wisconsin

Wiedemann Machine Co.
4272 Wissahickson Avenue
Philadelphia 32, Pennsylvania

Winton Heat Treating Co.
20003 West Lake Road
Cleveland 16, Ohio

Robert Wooler
Limekiln Pike
Dresher, Pennsylvania

World's Largest
BRASS ANNEALING FURNACE
EMPLOYS PSC FIXTURES



Scovill's New Continuous Strip Mill Called "The Most Modernly Equipped"

With various production facilities that rank as the world's largest, the new brass strip mill of Scovill Manufacturing Co. at Waterbury, Conn., is also recognized as "the most modernly equipped".

Pressed Steel Co. light-weight heat-treating trays were chosen to convey the 2,000 lb. coils through the two brass annealing furnaces, also the world's largest. Pictured here, these PSC trays are seamless-formed of Inconel, are 1/4" thick, 28 3/4" in diameter, and weigh 32 lbs. each. Under direct fire, 32,500 lbs. of coiled sheet are annealed per hour.

Pressed Steel Co. offers you the benefit of 20 years experience in designing heat-treating equipment. Alloy seamless formed or welded, in any size or design: annealing and carburizing boxes, covers, baskets, racks, tubes, retorts, etc. We fabricate the complete list of alloys, permitting you to choose the metal that is "alloy right" for your needs. Send blue prints or write as to your needs.

PSC EQUIPMENT IS "ALLOY RIGHT"

THE PRESSED STEEL COMPANY
of WILKES-BARRE, PENNSYLVANIA

Industrial Equipment of Heat and Corrosion Resistant WEIGHT-SAVING *Sheet Alloys*

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